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NOTES ON GEOGRAPHIC DISTRIBUTION

Moorish Viper, *Daboia mauritanica* (Gray, 1849) (Squamata, Viperidae), in Algeria: new provincial records, range extension, and an update on its distribution

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Abstract. *Daboia mauritanica* (Gray, 1849), Moorish Viper, is native to North Africa. We update the distribution map for this species in Algeria, providing 19 new locality records, filling distribution gaps and significantly expanding the species' known range. Our updated distribution map reveals a widespread presence of the species in northern Algeria, extending south into the northern Sahara. We note that some historical records in certain provinces remain unconfirmed and/or questionable, indicating the need for further investigation. Our findings underscore the importance of collaboration between researchers and citizen scientists in Algeria.

Key words. Citizen science, North Africa, reptile, Sahara

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INTRODUCTION

Our current understanding of the diversity and distribution patterns of reptiles in Algeria remains largely limited to century-old literature, which often exhibits data quality issues related to spatial uncertainties. Furthermore, extensive areas within the country lack comprehensive herpetological surveys, resulting in poorly understood and often data deficient geographical distributions for many taxa (Beddek 2017; Beddek et al. 2018). However, there has been a notable recent scientific resurgence of local interest in Algeria's reptiles, as evidenced by several recent published studies. These studies have led, inter alia, to the discovery of previously undocumented taxa within the country (Rouag et al. 2016; Mouane et al. 2021a; Boulaouad et al. 2023), and expansion of knowledge of the distributions of several species (Bakhouche and Escoriza 2017; Saoudi et al. 2017; Sadine et al. 2021; El Bouhissi et al. 2022), including vipers (Bouam et al. 2019, 2022).

Daboia Gray, 1840 is a genus of Old World vipers that currently comprises four recognized species: *D. palaestinae* (Werner, 1938), *D. russelii* (Shaw & Nodder, 1797), and *D. siamensis* (Smith, 1917), all native to Asia, and *D. mauritanica* (Gray, 1849), endemic to North Africa (Uetz et al. 2023). The latter species, known as the Moorish Viper and الأفعى الموريطانية in Arabic, has a West Mediterranean chorotype and is almost restricted to the Mediterranean region of North Africa, with a distribution that ranges from Western Sahara to north-western Libya, encompassing Morocco, northern Algeria, and Tunisia (Martínez-Freiría et al. 2017). It is found in subhumid to arid bioclimatic zones and inhabits elevations from sea level up to 2300 m, with a preference for stony slopes, hills, and mountain valleys (Figure 1A) (Schleich et al. 1996; Geniez 2015).

Since its first description in 1849, Moorish Viper has undergone numerous taxonomic and nomenclatural changes, including being separated into two distinct species: *D. mauritanica* and *D. deserti* (Anderson,

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Figure 1. Habitat and individuals of *Daboia mauritanica* from Algeria. **A.** Habitat of *Daboia mauritanica* in Sebseb, Ghardaïa Province. **B.** Adult specimen with a dark undulating stripe on its back, observed in Sebseb, Ghardaïa Province. **C.** Adult specimen with pale dorsal markings, observed in Aïn M'lila, Oum El Bouaghi Province. **D.** Adult specimen devoid of any dorsal markings, observed in Ain Deheb, Tiaret Province. Photographs **A–B** by AC, **C** by Tahar Mebarki and **D** by WD.

1892) (Kramer and Schnurrenberger 1963; Nilson and Andrén 1988; Herrmann et al. 1992; Lenk et al. 2001; Pyron et al. 2011). However, a recent study by Martínez-Freiría et al. (2017), based on phylogeographic and ecological niche analyses, suggested that all North African populations should be treated as *D. mauritanica* and that *D. deserti* is not a valid taxon. Furthermore, they identified seven well-supported geographically clustered lineages, with the Algerian, Tunisian, and eastern Moroccan populations forming a monophyletic lineage.

Herein, we compile occurrence records of *D. mauritanica* in Algeria from previous studies, and museums and online repositories, supplementing them with new data that include the species' first records in several wilayas (hereafter referred to as provinces). These findings fill distribution gaps and significantly extend the known geographic range of the species. We also provide an updated, comprehensive map of this species' distribution within the country.

METHODS

We obtained distributional records for *Daboia mauritanica* in Algeria from several sources: the Global Biodiversity Information Facility (GBIF 2024), available literature, museum and institutional specimens not yet digitized in GBIF (2024), and iNaturalist (2024). We ensured that all data included precise locality descriptions or were specified with GPS coordinates accurate to at least two decimal places. We avoided including records whose coordinates referred to the centroid of large geographic areas (e.g., counties), except for a few provinces where only a single record was available. We considered multiple records of the species from the same location as duplicates, likely resulting from repetitive data entry, and thus treated them as a single record (Table 1). We supplemented these records with additional data collected by the authors and citizen scientists from 2007 to 2023; this consisted of photographs of *D. mauritanica*, taken during systematic and opportunistic field observations, without any specimen collection. Citizen science data were provided with permission from the collectors, and their species identification was confirmed by us. The data also included other relevant information, such as the date and the exact locality from where each photo was taken. All specimen photographs were assigned catalogue numbers and deposited at the Laboratory "Biodiversités, Biotechnologie et Développement Durable" (BBDD), University of Batna 2 (UB2), and the "Laboratoire Agro-Biotechnologie et Nutrition en Zones Semi-Arides" (LANZA), University Ibn Khaldoun of Tiaret (UIKT). The final dataset comprised 88 presence localities, with 14 from GBIF (2024), 48 from available literature, two from undigitized museum and institutional specimens, five from iNaturalist (2024), and 19 from new records. We constructed the distribution map of the species in Algeria using ArcGIS v. 10.8.

RESULTS

Daboia mauritanica (Gray, 1849)

New records. ALGERIA – **Aïn Defla** • El Attaf, Djebel Tamoulga; 36.2139, 001.6419; 271 m elev.; 24.XI.2023; Yacine Kharoubi obs.; 1 adult, sex indet., BBDD-UB2-REP1 – **Béchar** • Beni Ounif, Hassi ed Dib; 32.1061,

Table 1. Province, coordinates, and source of available records of *Daboia mauritanica* in Algeria. USNM: Smithsonian Institution, National Museum of Natural History, Washington, USA; MNHN: Muséum National d'Histoire Naturelle, Paris, France; BEV: Collection Biogéographie et Ecologie des Vertébrés, Laboratoire de biogéographie et écologie des vertébrés, Montpellier, France; NHMUK: Natural History Museum, London, UK; SMF: Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany. Acronyms follow Sabaj (2020).

Province	Latitude	Longitude	Source(s)
Aïn Témouchent	35.29	−001.37	Doumergue (1901)
Aïn Témouchent	35.40	−001.12	Doumergue (1901)
Aïn Témouchent	35.60	−001.11	GBIF (2024)
Aïn Témouchent	35.64	−001.05	GBIF (2024)
Algiers	36.76	003.05	Gray (1849); Anderson (1892); Nilson and Andrén (1988); USNM 6210
Annaba	36.88	007.61	Boulenger (1891); Anderson (1892)
Batna	35.65	006.08	Martínez-Freiría et al. (2017)
Béchar	32.07	−001.32	Werner (1914)
Béjaïa	36.53	004.79	iNaturalist (2024)
Béjaïa	36.46	004.52	Martínez-Freiría et al. (2017)
Biskra	34.40	005.80	Martínez-Freiría et al. (2017)
Bordj Bou Arreridj	35.92	004.59	GBIF (2024)
Constantine	36.40	006.60	MNHN-RA-1988.2497; MNHN-RA-1988.4000
Djelfa	34.70	003.30	Olivier (1894)
El Bayadh	33.66	001.11	GBIF (2024)
El Bayadh	32.88	000.56	Martínez-Freiría et al. (2017)
El Bayadh	33.02	000.09	Sergent (1919)
El M'Ghair	33.96	005.91	Martínez-Freiría et al. (2017)
El M'Ghair	33.78	005.93	Martínez-Freiría et al. (2017)
El Oued	33.36	006.85	Wallach et al. (2014)
Jijel	36.65	006.30	Martínez-Freiría et al. (2017)
Khenchela	34.89	006.88	iNaturalist (2024)
Laghouat	33.80	002.90	Sergent (1919)
Mascara	35.19	−000.10	Martínez-Freiría et al. (2017)
Mila	36.07	006.19	iNaturalist (2024)
Mila	36.10	006.05	iNaturalist (2024)
Mostaganem	35.91	000.11	Olivier (1894)
M'sila	35.10	004.02	Martínez-Freiría et al. (2017)
M'sila	35.19	004.18	Olivier (1894)
M'sila	35.41	004.34	Seurat (1930)
Naâma	32.70	−000.47	GBIF (2024)
Naâma	33.59	−000.23	GBIF (2024)
Naâma	33.33	−000.34	GBIF (2024)
Naâma	33.58	−000.39	GBIF (2024)
Naâma	33.57	−000.28	GBIF (2024)
Naâma	33.48	−000.25	GBIF (2024)
Naâma	33.46	−000.39	GBIF (2024)
Naâma	33.43	−000.22	iNaturalist (2024)
Naâma	32.74	−000.58	Martínez-Freiría et al. (2017)
Naâma	32.67	−000.58	Werner (1914)
Oran	35.67	−000.88	BEV.12809
Oran	35.67	−000.68	Doumergue (1901)
Oran	35.69	−000.67	Doumergue (1901)
Oran	35.70	−000.66	Doumergue (1901)
Oran	35.72	−000.60	Doumergue (1901)
Oran	35.79	−000.21	Doumergue (1901)
Oran	35.80	−000.32	Doumergue (1901)
Oran	35.82	−000.36	Doumergue (1901)
Oran	35.84	−000.45	Doumergue (1901)
Oran	35.85	−000.42	Doumergue (1901)
Oran	35.76	−000.49	Doumergue (1901); Sergent (1919)
Oran	35.62	−000.73	Doumergue (1901); Sochurek (1956)

Province	Latitude	Longitude	Source(s)
Oran	35.68	−000.92	GBIF (2024)
Oran	35.69	−000.67	Guichenot (1850); Strauch (1862); Doumergue (1901); MNHN-RA-0.4017; NHMUK 1896.1.28.11
Oran	35.69	−000.92	Martínez-Freiría et al. (2017)
Oran	35.86	−000.33	Olivier (1894); Doumergue (1901)
Oran	35.68	−000.79	Sochurek (1956); SMF 66892
Ouargla	31.95	005.33	Wallach et al. (2014)
Saïda	34.92	−000.19	Doumergue (1901)
Sétif	36.12	005.47	GBIF (2024)
Sidi Bel Abbès	34.48	−000.78	Doumergue (1901)
Tébessa	34.48	007.56	Martínez-Freiría et al. (2017)
Tiaret	35.07	001.41	Ferrer et al. (2016)
Tipaza	36.55	001.89	Martínez-Freiría et al. (2017)
Tizi-Ouzou	36.65	004.54	Martínez-Freiría et al. (2017)
Tizi-Ouzou	36.72	004.03	Martínez-Freiría et al. (2017)
Tlemcen	34.61	−001.30	Doumergue (1901)
Tlemcen	35.14	−001.68	GBIF (2024)
Tlemcen	35.10	−001.85	Olivier (1894); Llabador (1947)

−001.8997; 1365 m elev.; 06.VIII.2022; Brahim Benabdallah obs.; 1 adult, sex indet., BBDD-UB2-REP2 • Béchar; 31.8012, −001.7846; 809 m elev.; 04.IV.2020; Brahim Benabdallah obs.; 1 adult, sex indet., BBDD-UB2-REP3 • Boukaïs; 31.9297, −002.5003; 921 m elev.; 16.VI.2018; Brahim Benabdallah obs.; 1 adult, sex indet., BBDD-UB2-REP4 • Taghit; 31.1243, −002.1927; 687 m elev.; 17.IV.2017; Brahim Benabdallah obs.; 1 adult, sex indet., BBDD-UB2-REP5 – **Biskra** • El Ghrous; 34.7569, 005.1832; 248 m elev.; 16.I.2023; Fouad Guided obs.; 1 adult, sex indet., BBDD-UB2-REP6 • El Ghrous; 34.7004, 005.2664; 157 m elev.; 08.V.2015; SES obs.; found near a palm grove; 1 adult, sex indet., BBDD-UB2-REP7 • M'Chouneche, Oued El Abiod; 34.9280, 005.9866; 306 m elev.; 21.VII.2017; SES obs.; rocky terrain, near a cliff; 1 adult, sex indet., BBDD-UB2-REP8 – **Ghardaïa** • Sebseb, Gueffafa; 32.1619, 003.2309; 629 m elev.; 01.VI.2020, 08:45 h; AC obs.; basking close to a water source within rocky plateaus and cliffs crossed by a dry wadi with scattered vegetation and palm trees (Figure 1A); total length ≈ 120 cm; 1 adult, sex indet., BBDD-UB2-REP9 (Figure 1B) – **Médéa** • Cheniguel, Oulad Bou Aïcha; 35.9180, 003.4952; 818 m elev.; 29.VIII.2022; Karim Bouaicha obs.; 1 adult, sex indet., BBDD-UB2-REP10 – **Oum El Bouaghi** • Aïn M'lila; 35.9793, 006.4994; 1098 m elev.; 27.VII.2023; Tahar Mebarki obs.; 1 adult, sex indet., BBDD-UB2-REP11 (Figure 1C) – **Saïda** • Youb, Sidi Douma; 34.8403, −000.2474; 766 m elev.; 15.VIII.2022; MEB & Khaled Radjaa obs.; found on a sandy soil in a plant nursery next to a farm; 1 adult, sex indet., BBDD-UB2-REP12 – **Sidi Bel Abbès** • Aïn Adden, Guettarnia forest; 35.2941, −000.2257; 715 m elev.; 11.V.2021; Miloud Dai obs.; maquis of mastic and kermes oak trees; 1 adult, sex indet., BBDD-UB2-REP13 • Merine, Ramla; 34.8132, −000.3764; 901 m elev.; 16.VII.2019; MEB & Zouaoui Khacheb obs.; found on stones next to a clump of mastic trees; 1 adult, sex indet., BBDD-UB2-REP14 • Tenira, Tenira forest; 34.9846, −000.4679; 859 m elev.; 16.IX.2020; MEB & Makhfi Meghazi obs.; rocky terrain within a thicket of Sandarac trees; 1 adult, sex indet., BBDD-UB2-REP15 • Télagh, Khoudida forest; 34.8134, −000.4934; 879 m elev.; 19.VII.2021; Zouaoui Khacheb obs.; found on a road next to a degraded scrubland; 1 adult, sex indet., BBDD-UB2-REP16 – **Tiaret** • Ain Deheb; 34.7157, 001.4677; 1030 m elev.; 17.IV.2015; WD & MAH obs.; a steppe; 1 adult, sex indet., LANZA-UIKT-REP1 (Figure 1D) • Nadorah; 35.2065, 001.9131; 1088 m elev.; 12.VI.2007; WD obs.; A steppe; 1 adult, sex indet., LANZA-UIKT-REP2 • Rechaïga; 35.1755, 002.2650; 1202 m elev.; 15.VII.2009; WD & MAH obs.; degraded steppe; 1 adult, sex indet., LANZA-UIKT-REP3.

Identification. While *D. mauritanica* is unlikely to be misidentified as any other snake species in North Africa by trained herpetologists (Schleich et al. 1996; Geniez 2015), it is essential to acknowledge that laypeople may confuse it with species such as *Spalerosophis dolichospilus* (Werner, 1923), *Hemorrhois hippocrepis* (Linnaeus, 1758), and *Natrix maura* (Linnaeus, 1758). It is characterized by its large size (maximum length of 181 cm), robust cylindrical body, and short tail. The head is broad and triangular, distinct from the neck, and covered by small scales that are typically unkeeled or feebly keeled on the upper part. The snout is generally rounded, but it can also be more or less pointed. The nostrils are laterally positioned, and the eyes are moderately large, with a vertical pupil and an iris that is either golden or orange. *Daboia mauritanica* exhibits a wide range of geographical variation in morphological and/or coloration traits, which may originate from local adaptation or phenotypic plasticity (Martínez-Freiría et al. 2017). In some specimens, the canthus rostralis is pronounced, while in others it is not distinct. The colouration of *D. mauritanica* is extremely variable (Figure 1B–D), with the ground colour ranging from shades of grey, brown, red, orange, to sand-coloured. The dorsal colouration typically features a dark undulating stripe on the back, which can sometimes be partially replaced by round or oval blotches. The dorsal markings may also be pale or completely absent, and it is not uncommon to find specimens with no markings, especially in arid habitats.

The flanks contain large dark blotches that may also be faint, alternating with the dorsal blotches. The head is usually unmarked above, with or without a dark stripe extending from behind the eye to the corner of the mouth, and often another vertical stripe from below the eye to the corner of the mouth.

DISCUSSION

We documented 19 new locality records for *Daboia mauritanica* in Algeria, which include the first records for the provinces of Aïn Defla, Médéa, and Ghardaïa (Figure 2). The majority of these newly reported occurrences fall within the species' predicted geographic range (Martínez-Freiría et al. 2017), except for records from Taghit and Sebseb, which are located respectively in the southern regions of Béchar (western Algeria) and Ghardaïa (north-central Algerian Sahara). These records are of particular significance as they extend the known geographic range of the species approximately 135 km and 185 km southward from the nearest known localities, namely Djebel Melias (Werner 1914) and Laghouat (Sergent 1919) respectively. Elevations of all records ranged from 157–1364 m a.s.l. Climatic data for these localities, extracted from the WorldClim database at a resolution of ~1 km^2 (Fick and Hijmans 2017), indicate that the two areas have similar climatic conditions. They both fall within the superior Saharan bioclimatic zone, and are characterized by temperate winters and mean annual precipitation of 62 mm. The presence of *D. mauritanica* in these areas suggests that the species may have a broader niche breadth than previously thought (Martínez-Freiría et al. 2017). Alternatively, these occurrences may be linked to specific microclimatic conditions in the Sahara, such as the humid environments provided near small rivers. These conditions are not fully accounted for by existing climatic data or regional ecological niche models.

The updated distribution map of *D. mauritanica* in Algeria (Figure 2) shows that the species is widespread throughout most of northern Algeria, extending northward along the Saharan Atlas and reaching as far south as the northern Sahara, including southern Béchar and Ghardaïa, and probably El Oued and Ouargla provinces (see below). Still, the species' presence in certain provinces remains questionable and/or unconfirmed for the past 50 years. Specifically, Boulenger (1891) reported the species from Mount Edough in Annaba Province based on Fernand Lataste's observation of specimens in M. Hénon's collection, but Lataste himself expressed doubts about the accuracy of this locality. Records from Algiers (Gray 1849; Anderson 1892; Nilson and Andrén 1988) were based on museum specimens lacking precise collection dates but believed to be before 1974. Similarly, Djelfa, Laghouat, and Mostaganem were reported as locations where the species was found (Olivier 1894; Sergent 1919; Seurat 1930), but no records have been reported from these provinces in the past 50 years. Wallach et al. (2014) mentioned the occurrence of *D. mauritanica* in El Oued and Ouargla, but they did not provide specific location data. The existence of the species in these two provinces is questionable and requires further confirmation considering the absence of suitable habitat, specifically mountain units (Brito et al. 2011; Geniez 2015) and the lack of sightings of the species despite intensive surveys in the region (personal observation; Mouane et al. 2013, 2021b).

The new data presented in this study are of paramount importance for the species' conservation, as they offer valuable insights that can inform future conservation efforts, particularly since *D. mauritanica* is listed as Near Threatened by the IUCN (Miras et al. 2006a, 2006b) and is responsible for most cases of envenomation in Algeria (Geniez 2015). Moreover, this study underscores the significance of citizen science in improving our understanding of the extent of species occurrence and distribution, emphasizing the need for enhanced collaboration between researchers and citizen scientists in Algeria.

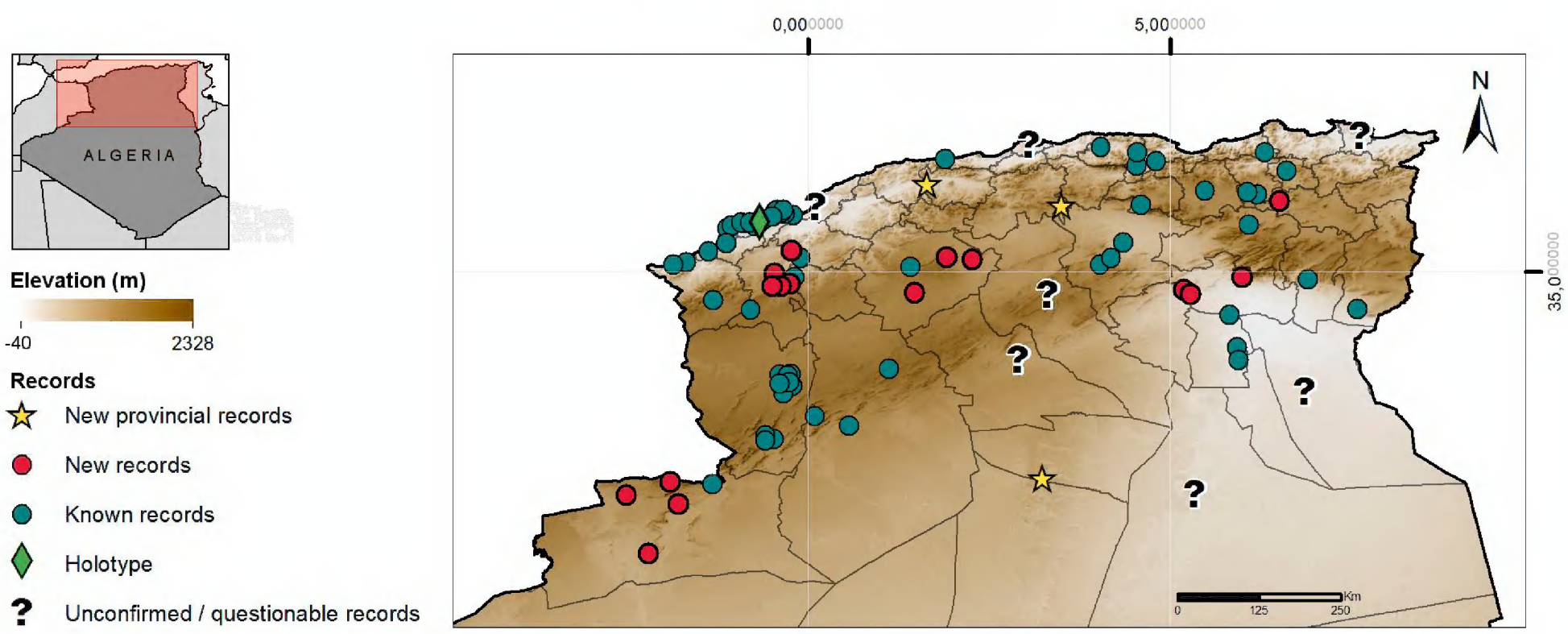

Figure 2. Distribution map of *Daboia mauritanica* in Algeria.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: AC. Data curation: AC, IB, MTM, SES. Formal analysis: AC, IB, MTM. Investigation: AC, MEB, WD, MAH, MM, SES. Visualization: AC, IB. Project administration: SES. Writing – original draft: AC, IB, SES. Writing – review and editing: MEB, WD, MAH, MTM, MM.

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Data availability

All data that support the findings of this study are available in the main text and in the Laboratory "Biodiversités, Biotechnologie et Développement Durable" (BBDD), University of Batna 2 (UB2), and the "Laboratoire Agro-Biotechnologie et Nutrition en Zones Semi-Arides" (LANZA), University Ibn Khaldoun of Tiaret (UIKT).

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